SELF-PRIMING CENTRIFUGAL PUMP
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ABSTRACT OF THE DISCLOSURE

A shaft rotated lubricating pump including a hollow body provided with a storage-edge for confining a rotating ring of liquid. Passages in the hollow body for discharging the confined liquid onto bearings. A centrifugal compressor attached to the hollow body for venting gases and surplus lubricant from the hollow body. The compressor is provided with a peripheral splash ring to dip into the liquid of the storage chamber for slow speed lubrication of the bearings.

The invention concerns a self-priming centrifugal pump, particularly for conveying lubricating oil, which is located above the level of the liquid that has to be conveyed and is mounted on the shaft of a high-speed turbomachine.

Such pumps for conveying liquids consist mainly of a hollow body which rotates in a casing, the liquid being supplied at least at one open end to the hollow body and then expelled again through channels. If the openings at the ends of the hollow body are restricted, then a ring of liquid builds up when the supply is adequate and the liquid which is thus under a pressure is discharged continuously through the channels. Centrifugal pumps of this kind can only overcome a suction head if they are filled with liquid. When for instance the pump has to be used for lubricating the bearing of a high-speed turbomachine, it would be feasible to arrange it on the shaft of the machine so that it can operate at the same speed as the latter. The difficulty is, however, that the machine shaft is generally arranged above the level of the liquid that has to be conveyed. When the machine is at a standstill the liquid thus flows out of the pump and gas flows in from the surrounding air. The pumping head of a centrifugal pump is proportional to the density of the medium to be conveyed and to the square of the peripheral speed. When the pump impeller instead of being filled with the liquid is for instance full of a gas which is 700 times lighter, the peripheral speed would have to be very high in order to overcome the suction head and to bring the liquid into the pump. Due to the high displacement work this would, however, not be suitable for a bearing lubrication for instance.

Another possibility of avoiding the inadequate priming effect is to supply the liquid to the pump with an unnatural pressure gradient. When the pump has a vertical shaft it could be arranged so that it is submerged or filled with liquid when it has to be put into operation. Both possibilities can, however, seldom be realised in practice.

Furthermore, in all the aforementioned cases it is impossible to guarantee that the pump will operate reliably. Investigations have shown, that gas, which was contained in the liquid collects inside the hollow pump body and was either transported along with the liquid or resulted from its evaporation.

This can cause an interruption in the flow of the liquid in the suction pipe. Once the pumping process is interrupted it cannot automatically recommence again.

The object of the invention is to produce a centrifugal pump which, without the known auxiliary devices or special conditions, is self-priming and where the operational safety is not endangered by gases which collect inside the hollow body. This object is achieved in accordance with the invention by means of a combination of the following features:

A suction pipe of which one end dips into the liquid to be conveyed and the other end is in communication with the central hollow chamber of the pump body;

An additional pump impeller with vent channels which communicate with the atmosphere and the hollow chamber of the pump body in which an underpressure is produced during service;

A storage-edge by means of which under the influence of the centrifugal force a liquid ring is formed in the hollow chamber of the pump body from the liquid flowing out of the suction pipe;

Channels in the pump body for discharging the liquid from the liquid ring to the consumer points;

Auxiliary channels in the pump body in communication with the atmosphere for discharging the liquid which rises above the storage edge.

The invention is explained in more detail by means of two constructional examples which are shown in axial sectional view in FIGURES 1 and 2 respectively. The same elements are designated by the same numerals in both figures.

In FIG. 1 the hollow body 1 of a centrifugal pump is connected directly to the shaft 2 of a high-speed turbomachine which is supported by ball bearings 3 in a casing 4. When the pressure in the hollow chamber 5 is sufficiently below atmospheric pressure, the liquid that has to be conveyed is sucked through the suction pipe 7 into the hollow chamber where it is caused to rotate due to the frictional effect of the chamber wall, possibly supported by built-in radial blades (not shown). Due to the influence of the centrifugal force, a liquid ring 8 is formed from which the liquid is conveyed through channels 9 to the place where it is utilized.

One of the most important conditions for the regular operation of such a pump is that the radial thickness of the oil ring 8 remains constant. This thickness can, as known, be determined by means of a storage edge 10, but for this purpose more liquid must flow into the hollow body than can pass away through the channels 9. The liquid which flows over the storage edge is discharged through auxiliary channels 11, so that the level of the liquid ring always coincides with the height of the storage edge.

For producing the lower pressure required in the hollow body 1 in order to be able to suck in the liquid, an additional pump impeller 12 having preferably radial vent channels 13 is provided, these channels being in communication with the hollow chamber 5 and the atmosphere. This impeller acts as a radial blower and has to remove the gases which have collected in the hollow chamber so that the required lower pressure can be produced. The inlet openings of channels 13 are therefore generally located in the vicinity of the axis of rotation.

When dimensioning the pump impeller and the vent channels, it is to be noted that during a standstill the liquid normally flows out of the pump and the hollow chamber 5 is filled with vapour or gas to that when the pump is started the underpressure which is produced causes further gas to be sucked in through all channels and leaks and all this has to be discharged through the vent channels. It is therefore necessary that on the one hand the difference between the radii on which the outlet and inlet openings of the vent channels lie and on the other hand the sum of their cross-sections should be so dimensioned that the underpressure occurring in the
hollow chamber 5 is sufficient to overcome the suction height of the liquid that has to be conveyed. As soon as the liquid is sucked in through pipe 7 the pump commences to convey the liquid through channels 7 and possibly also through auxiliary channels 11 and now only the gas has to be conveyed away that has entered the hollow chamber 5 by way of unavoidable leaks or with the liquid.

Between the suction pipe 7 and the hollow body 1 there is a seal for instance as indicated by the sealing ring 14. Any expedient sealing device, even a small air gap, can be provided with a vertical shaft it would also be possible to extend the end 15 of the hollow body in the form of a pipe which is enclosed by a stationary body and is allowed to dip directly into the liquid.

For the embodiment of the invention shown in FIG. 1, an oil pump has been chosen which splashes the oil directly on to the ball bearing 3. In this case the pump impeller 12 is made so large that even at a comparatively low speed the suction head is so large that oil rises in pipe 7. In order to ensure that the bearing is already lubricated at this stage a splash ring 16 can be provided on the periphery of the pump impeller 12 which dips into the oil sump. Oil is thus already splashed on to the casing 4 at a low pump speed and flows through channel 17 into the storage chamber 19 which is formed with the aid of the blocking ring 18, whereby the oil reaches the bearing. At a high speed this oil flow ceases, because the air which is carried along with the pump impeller 12 displaces the oil.

The auxiliary channels 11 can also be used to cool the lubricating medium by whirling it against a cooled wall or a cooler. This type of cooling is particularly effective because no stagnation of the flow is caused by the cooled oil at the cooling point. It is continuously carried away by the impact of the fresh oil.

The pump according to the invention can also be used for separating out such particles which are heavier than the liquid, for instance chips resulting from a machining operation, casting sand, or other contaminating particles. This is achieved by means of the annular enlargement 20 of the hollow chamber 5 which lies radially further outwards than the inlet openings of the channels 9. A small space is adequate for this purpose when the lubricating oil system is a closed circuit, because during operation no further foreign substances can enter the system. By means of this device the liquid channels 9 or the auxiliary channels 11 are prevented from becoming obstructed because the impurities are removed by the centrifugal effect and collect in the enlargement 20 where they can be removed when the pump is at a standstill.

In the modified embodiment of the invention shown in FIG. 2, the stationary annular part which surrounds the hollow body 1 is constructed in the form of a bushing 21 for a plain bearing, whereby the hollow body forms the bearing neck. An adequate amount of oil has to be supplied to the running surface. It is therefore necessary to suck in more oil than is required, and to convey away the surplus by means of storage edge 10 and auxiliary channels 11. The inlets of the vent channels 13 are located on a still smaller diameter.

The centrifugal pump according to the invention is suitable for all liquids, even those which readily evaporate and the conveyance of which has so far presented great difficulties. Even when starting up, the pump is capable of producing the desired underpressure which is required for priming the pump, without any additional equipment having to be provided. An interruption of the pumping effect due to gases or vapours collecting inside the pump is absolutely impossible.

1. Self-priming centrifugal pump, particularly for conveying lubricating oil, which is located above the level of the liquid to be conveyed and is mounted on the shaft of a high-speed turbomachine, characterised by the combination of the following features:

- a rotating pump body having a central hollow chamber;
- a fixed suction pipe of which one end dips into the liquid to be conveyed and the other end is in communication with the central hollow chamber of the pump body;
- an additional pump impeller with vent channels which communicate with the atmosphere and the hollow chamber of the pump body in which an underpressure is produced during service;
- a storage-edge by means of which under the influence of the centrifugal force a liquid ring is formed in the hollow chamber of the pump body from the liquid flowing out of the suction pipe;
- channels in the pump body for discharging the liquid from the liquid ring to the consumer points;
- auxiliary channels in the pump body in communication with the atmosphere for discharging the liquid which rises above the storage edge.

2. Centrifugal pump as in claim 1, characterised by an annular enlargement of the hollow chamber which lies radially further outwards than the inlet openings of the liquid channels.

3. Centrifugal pump as in claim 1, characterised by a splash ring on the periphery of the pump impeller, said ring being arranged to dip into the liquid.

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